

Appl. No. 09/274,194

Request for Reconsideration: dated January 27, 2004

Reply to Final Office Action of September 30, 2003

Remarks/Arguments

The Examiner is thanked for the careful review of this application. Applicant submits this Request for Reconsideration in response to the Final Office Action, dated September 30, 2003, issued in the Application. Claims 20-38 are pending.

Rejections under 35 U.S.C. § 103(a)

It is respectfully submitted that claims 20-38 are patentable over U.S. Patent No. 6,066,569 to Tobben in view of U.S. Patent No. 5,700,740 to Chen et al. (Chen).

Independent claims 20, 26, and 34 recite a method for removing photoresist material from a semiconductor substrate and a method for forming a semiconductor substrate. Each of the independent claims 20, 26, and 34 recites that the photoresist layer is removed from over the hard mask layer with dimethyl sulfoxide of a high pressure liquid chromatography (HPLC) grade (claims 20 and 34) or dimethyl sulfoxide (claim 26). Each of the independent claims, 20, 26, and 34 specifically recites that photoresist is removed by dissolving the photoresist layer. Particularly, the photoresist layer is removed from over the hard mask layer without substantially damaging the low dielectric constant layer due to the high selectivity of the chemical used.

As will be explained below, the combination of Tobben and Chen does not raise a *prima facie* case of obviousness against the subject matter defined in independent claims 20, 26, and 34 because not only the requisite suggestion or motivation to combine the references in the manner proposed by the Examiner is lacking but also the suggested combination fails to teach or suggest all of the features defined in independent claims 20, 26, and 34. Additionally, it is well established that if a proposed modification would render the prior art method being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. See M.P.E.P. § 2143.01.

In finding Applicant's previous arguments unpersuasive, in the Final Office Action, the Office contends that Chen teaches removing a photoresist layer by dimethyl-sulfoxide. The Office further acknowledges that Chen does not teach using low constant dielectric materials.

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It is respectfully submitted that although Chen teaches removing the photoresist layer by using a mixture of dimethyl-sulfoxide from over the dielectric layer, Chen does not teach or suggest using a hard mask or using the dimethyl-sulfoxide mixture to remove photoresist from over the hard mask, as defined in the claimed invention. As a consequence, Chen does not address or teach what can occur when dimethyl sulfoxide is applied over the hard mask. Thus, Chen cannot be relied upon for teaching that dimethyl sulfoxide can be used to remove photoresist from over the hard mask, as required in the claimed invention.

The Office further asserts that Tobben teaches removing a photoresist layer using oxygen plasma, and that it would have been obvious to a person of ordinary skill in the art at the time of the invention, to modify Tobben with Chen's method of using dimethyl-sulfoxide to remove the photoresist layer. In the Final Office Action, the Office acknowledges that Tobben is relied upon for teaching the use of low constant dielectric material.

It is respectfully submitted that in the claimed invention, the photoresist is removed from over the hard mask layer that has an opening extending through the entire width of the hard mask layer down to the upper surface of the low constant dielectric layer. Tobben, however, uses two different photoresist layers and two separate plasma etch processes to create an opening in the hard mask such that the opening does not extend through the entire width of the hard mask layer. Thus, when both of the photoresist layers defined in Tobben have been removed, the underlying low dielectric constant layer is still not exposed. Therefore, in contrast to the Office's contention, Tobben does not teach or suggest forming an opening in the hard mask layer such that the low dielectric layer is exposed. Nor does Chen teach that the remaining photoresist layer is then removed.

In Tobben, when the anisotropic etch is performed to remove the remainder of the hard mask. As a result, only the remaining layer of the hard mask is removed, so does a portion of the low constant dielectric. Specifically, during the anisotropic etch process in Tobben, it is imperative that the low constant dielectric is etched faster than the hard mask so that the pattern in the hard mask can be transferred to the underlying IMD. The remaining portion of the low constant dielectric layer is then etched during the last etch process.

Accordingly, while in the claimed invention the high selectivity of the HPLC or dimethyl sulfoxide toward the expose low dielectric material is claimed, using the HPLC or dimethyl sulfoxide in Tobben would be improper as Tobben relies on the anisotropic etch

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process to remove the remaining layer of the hard mask as well as a portion of the low dielectric layer. One of ordinary skill in the art using dimethyl sulfoxide to remove the second photoresist layer can achieve removing the photoresist layer, as the effect of DS on the hard mask has not been addressed in Chen or Tobben.

If the DS mixture could be used to remove the photoresist layer from over the hard mask and that DS were highly selective with respect to the hard mask (a proposition with which Applicant disagrees), at the end of such process the hard mask still remains on the dielectric layer of Tobben. Furthermore, an opening may not have been formed in the IMD. As can be appreciated, such result defeats the objective of Tobben and renders Tobben unsatisfactory for its intended purpose.

In the alternative, if the DS mixture could be used to remove the photoresist layer from over the hard mask and that DS were not selective with respect to the hard mask (a proposition with which Applicant disagrees), at the end of such process the hard mask is removed and an opening is formed, exposing the dielectric. At this point, however, if dimethyl sulfoxide asserted by the Office to be highly selective to the low constant dielectric is used, the pattern of the hard mask cannot be formed in the dielectric due to dimethyl sulfoxide incapability to dissolve the low constant dielectric. Thus, as modified using the alleged teachings of Chen, the method of Tobben is unsatisfactory for the intended purpose taught by Tobben.

As discussed in more detail by Applicant in the Request for Reconsideration filed on July 7, 2003 being incorporated herein in its entirety by this reference, Applicant asserts that the Office has yet to identify any objective rationale that would have motivated one skilled in the art to replace the plasma oxide etching taught in Tobin disclosed to be the prevalent method of removing photoresist layers by dissolving the photoresist layer, as defined in the claimed invention. Applicant further asserts that the Office has failed to establish that dimethyl sulfoxide inherently has a high selectivity toward a low dielectric constant material as Chen focuses on removing chloride-containing residues from sidewalls and not whether the dielectric has a low constant or not.

Accordingly, it is respectfully submitted that independent claims 20, 26, and 34 are patentable over the cited art of record, individually and collectively. Likewise, dependent claims 21-25, 27-33, and 35-38 are also submitted to be patentable over the cited art of record

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for at least the same reasons discussed above. Accordingly, Applicant respectfully requests that the § 103(a) rejections be withdrawn.

Applicant hereby submits that this Request for Reconsideration complies with 37 C.F.R. 1.116(b) and should be entered.

In view of the foregoing, Applicant respectfully submits that all of the pending claims 20-38 are in condition for allowance. Accordingly, a Notice of Allowance is respectfully requested. If the Examiner has any questions concerning the present Request for Reconsideration, the Examiner is kindly requested to contact the undersigned at (408) 749-6900, ext. 6913. If any fees are due in connection with filing this Request for Reconsideration, the Commissioner is also authorized to charge Deposit Account No. 50-0805 (Order No. LAM2P266).

Respectfully submitted,

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